Space Weather Technical Forecast

Issued on Monday, 10 July 2023 at 01:25 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Chance of fluence becoming Active (1e8 integrated pfu). Chance of R1/R2 radio blackouts throughout. Chance of G1/Minor storms Day 4 (13 July).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with isolated C-class flares observed in the past 24 hours. There are currently 11 sunspot regions on the visible disc, with a new, unnumbered region emerging across the southeastern limb. AR3361 in the northwest is the most magnetically complex region, with a delta spot and is designated a magnetic configuration Ekc / Beta-delta. AR3363 is the largest region and located in the southeast. AR3367 continues to grow near centre-disc. Two recently numbered regions AR3368 and AR3369, in the southwest, are also developing with rapid spot emergence prevalent in in the former region. The remaining regions remain generally unchanged. No Earth-directed CMEs have been observed in available imagery during the past 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind as observed at L1, showed a gradual declining trend through the last 24 hours. Solar winds starting slightly elevated just above 400 km/s and now at slow-ambient levels. The density was mostly below average. Total magnetic field strength has been weak throughout below 7 nT with a declining trend noted. The north-south component, Bz, also varying weakly. The phi angle has been mostly positive (away from the Sun). Geomagnetic activity has been at Quiet levels throughout (Kp 0-1).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as observed by GOES16 at GEO, was at background levels. High energy electron flux (greater than 2MeV), as observed by GOES16, was at background to moderate levels, with a peak of 861 pfu at 09/1450 UTC. The 24-hour integrated fluence was below the Active (1e8 integrated pfu) threshold with a slight rise. A fluence of 4.16e7 pfu was recorded at 10/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to moderate solar activity is forecast through the period with a slight chance (5%) of an isolated X-class flare, and currently the greatest risk of this comes from active region AR3361, located in the northwest.

Solar Wind / Geomagnetic Activity: No Earth directed CMEs are currently forecast. The solar wind is likely to be at Low levels for the first three days of this guidance period with perhaps some enhancements to slightly elevated levels. During Day 4 (13 July) a high speed stream (HSS) related to CH23/- is forecast to arrive with elevated solar winds probable. Geomagnetic activity is forecast to be Quiet to Unsettled (Kp1-3) through much of the period. However there is an increased risk of Active or minor geomagnetic storms/G1 (Kp4-5) during Day 4.

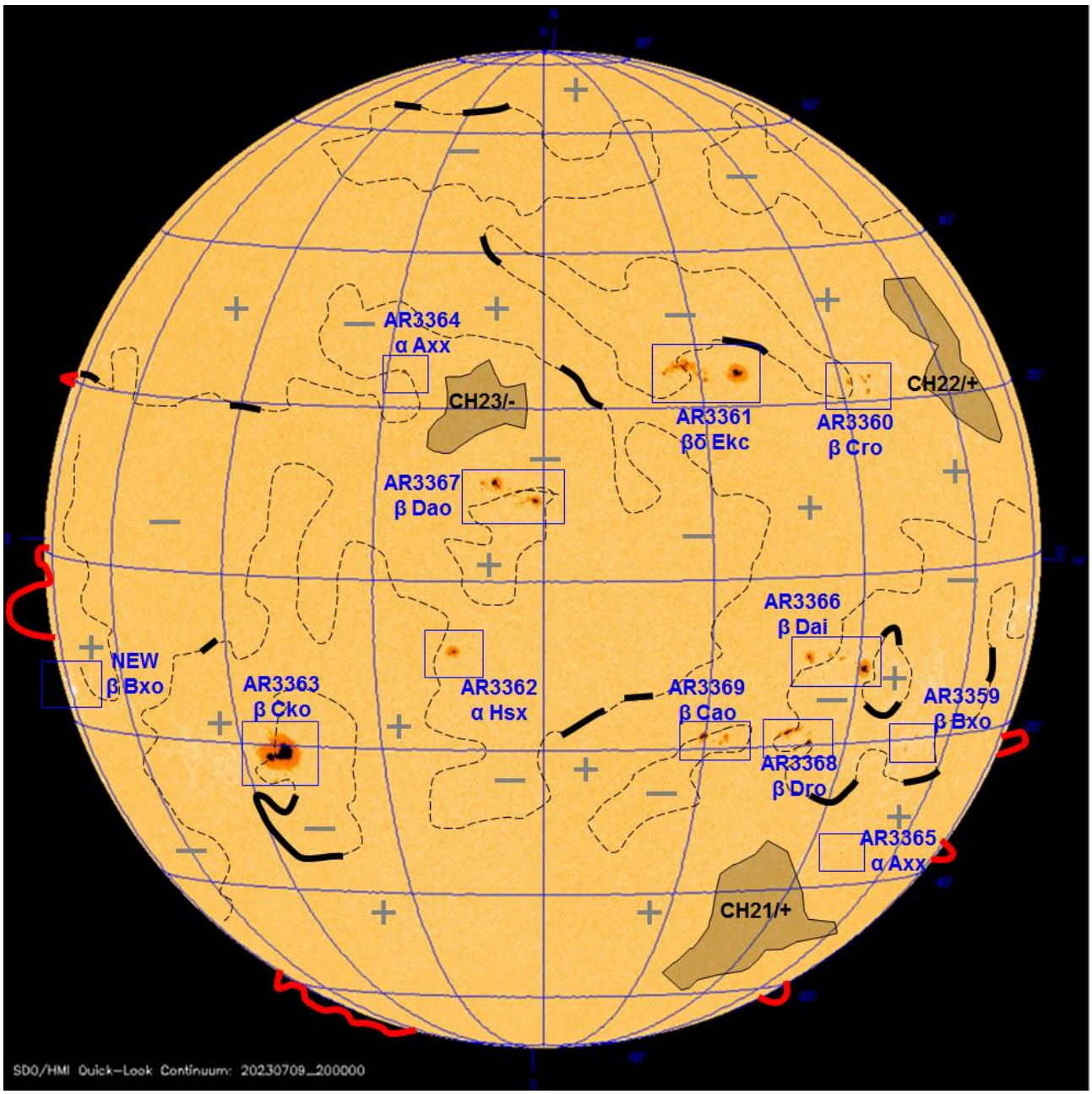
Energetic Particles / Solar Radiation: The high energy (greater than 10MeV) proton flux has a

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

slight chance of reaching the S1/Minor Storm threshold through the period, should any larger flares occur. High energy electron flux (greater than 2MeV) may reach high levels at each diurnal peak, perhaps with a decline during Day 4 (13 July) with onset of the HSS and accompanying geomagnetic activity. Electron fluence may rise further, with a chance of reaching Active (1e8 integrated pfu), before likely declining during Day 4 as the flux diminishes again.

Figure 1. Solar Analysis Valid 2000UTC, 9 July 2023.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

Geomagnetic Storms:

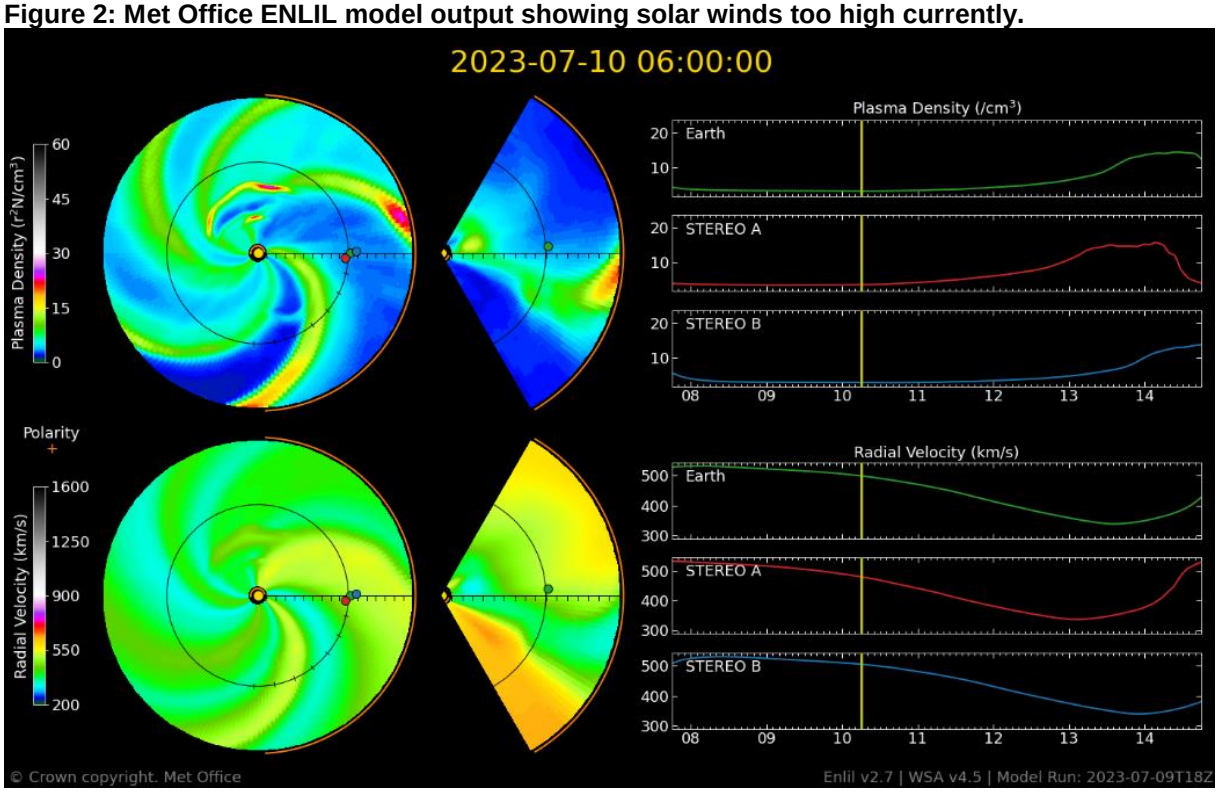
No Earth directed CMEs are currently expected.
The solar wind starting at slow-ambient levels may reach slightly elevated, levels through the guidance period. A HSS from CH23/- is likely to arrive during Day 4 (13 July), or perhaps just after the end of this period. On the previous rotation this feature resulted in solar winds reaching 600-700 km/s, and a maximum geomagnetic response of G2 / Moderate storm. On this rotation the feature appears smaller and more fragmented in appearance, and this will probably lead to lower solar wind levels and associated impacts. Geomagnetic activity is forecast to be Quiet to Unsettled, with an increasing risk of G1 / Minor storms during Day 4.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Met Office ENLIL model output showing solar winds too high currently.



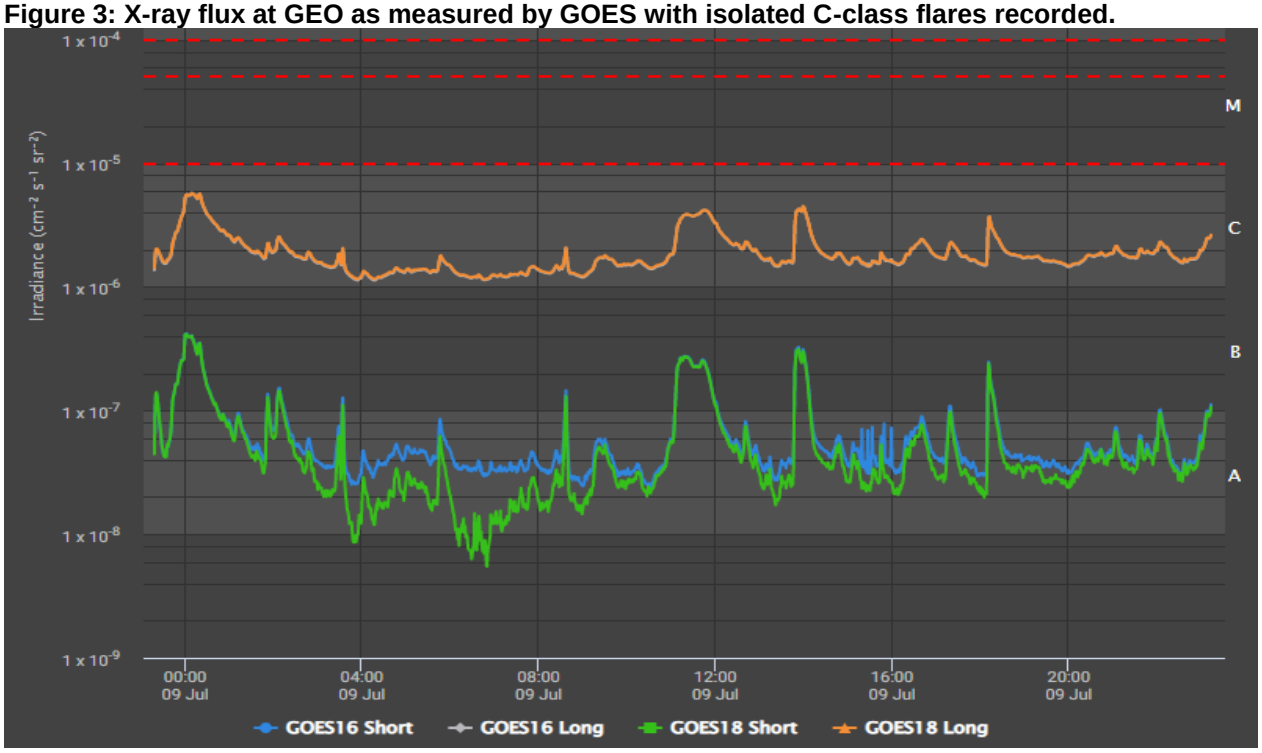
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

Radio Blackouts - X-Ray Flares:
Solar activity has been Low over the past 24 hours, with isolated C-class flares observed. There are currently 11 sunspot regions on the visible disc, with a new, unnumbered region emerging across the eastern limb. AR3361 ((Ekc/Beta-Delta) in the northwest is the most magnetically complex region, with a delta spot. AR3363 (Cko/Beta) is the largest region and located in the southeast. AR3367 (Dao/Beta) continues to grow near centre-disc. Two recently numbered regions AR3368 (Dro/Beta) and AR3369 (Cao/Beta, in the southwest, are also developing with rapid spot emergence prevalent in in the former region. The remaining regions remain generally unchanged. Low to moderate activity is likely, with a slight chance of an isolated X-class flare. No major active region is forecast to depart the visible disc during the period and far side sounding data suggests that further regions may rotate onto the disc during the coming days. As these regions rotate across the eastern limb the flare probabilities have been raised a little for days 3 and 4.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	50	50	60	60
Very Active	R3 to R5 X Class	No	10	10	20	20

Figure 3: X-ray flux at GEO as measured by GOES with isolated C-class flares recorded.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

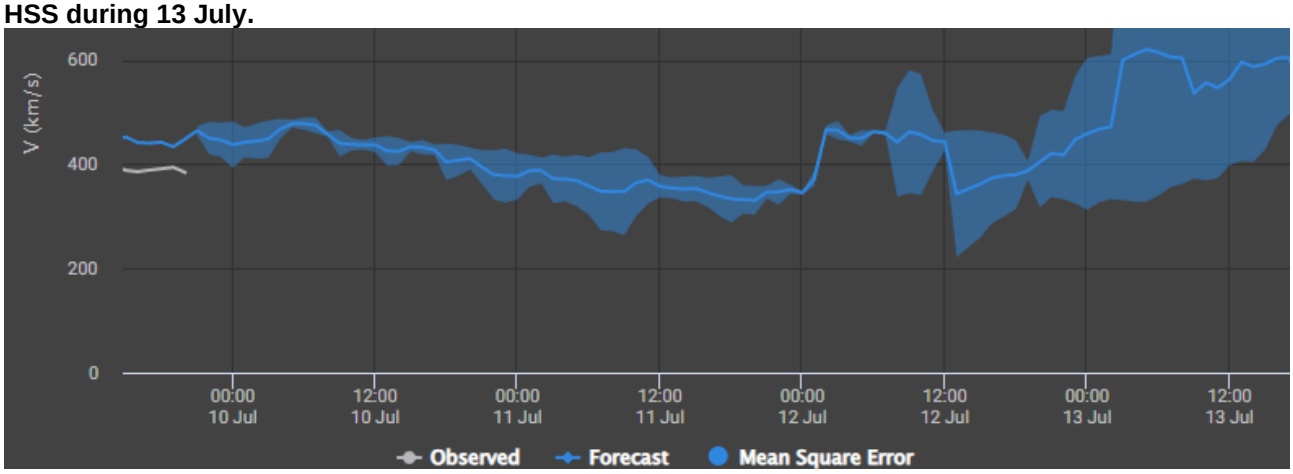
© Crown Copyright 2023. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):
The high energy (greater than 10MeV) proton flux, as observed by GOES16, is currently at background levels. There is a very slight chance of S1/Minor storm levels being reached through this period, should any larger flares occur mainly from regions in the western hemisphere.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: Met Office Solar Winds Prediction Model (SWPM) indicating probable arrival time of next HSS during 13 July.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) has remained at moderate levels in recent days. The BAS radiation belt model suggests some limited increase in electron flux has taken place below GEO, probably due to the recent HSS. As such, electron flux may reach high levels at the diurnal maxima in the coming days. With limited geomagnetic activity expected until the arrival of a further HSS on Day 4 (13 July), this pattern is likely to continue through much of the period before a probable sharper decline once the HSS sets in. Electron fluence has plateaued and remains below Active levels (1e8 integrated pfu). A further slight rising trend is possible, with a chance of reaching Active in the coming days, before a decline from Day 4. MOSWOC REFM guidance is showing a steady trend below Active, which may be reasonable, as confidence in the peak fluence level likely to be reached is currently low.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	20	30	30	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: High energy electrons at GEO as measured by GOES and Met Office REFM output.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.